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ABSTRACT

This report is part of a general study of Reference Measures for Cognitive and Noncognitive Factors. The specific activity that is being reported is the development of "factor-referenced" tests or "marker" tests for several cognitive factors related to divergent production (i.e., ability to produce a variety of words, phrases, or ideas in response to stimuli). Part of the development included a field test to improve the items in the tests, to determine the reliabilities of the tests, and to help clarify understanding of these cognitive factors. The results of the field experiment are reported. Seven factors were investigated: (1) associational fluency, (2) expressional fluency, (3) originality, (4) semantic relefinition, (5) sensitivity to problems, (6) figural adaptive flexibility, and (7) spontaneous semantic flexibility. (Author)

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PROBLEMS OF REPLICATION OF SEVEN DIVERGENT PRODUCTION FACTORS

Ruth B. Ekstrom, John W. French
and Harry H. Harman

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This report is part of a general study of Reference Measures for Cognitive and Noncognitive Factors. The specific activity that is being reported in the development of "factor-referenced" tests or "marker" tests for several cognitive factors related to divergent production (i.e., ability to produce a variety of words, phrases, or ideas in response to stimuli). Part of the development included a field test to improve the items in the tests, to determine the reliabilities of the tests, and to help clarify understanding of these cognitive factors. The results of the field experiment are reported.

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The seven factors that were investigated are as follows: (1) associational fluency, (2) expressional fluency, (3) originality, (4) semantic redefinition, (5) sensitivity to problems, (6) figural adaptive flexibility, and (7) spontaneous semantic flexibility.

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Problems of Replication of Seven Divergent Production Factors

Ruth B. Ekstrom, John W. French, and Harry H. Harman

This report is part of a general study of Reference Measures for Cognitive and Noncognitive Factors. The specific activity that is being reported is the development of "factor-referenced" tests or "marker" tests for several cognitive factors related to divergent production (i.e., ability to produce a variety of words, phrases, or ideas in response to stimuli). Part of the development included a field test to improve the items in the tests, to determine the reliabilities of the tests, and to help clarify understanding of these cognitive factors.

The first step in this study was to select factors for which it would be desirable to have new marker tests in the planned revision of the Kit of Reference Tests for Cognitive Factors. In earlier editions of the Kit several factors were marked by instruments developed by J. P. Guilford. However, because of copyright problems it was deemed advisable to have all tests in the new edition of the Kit copyrighted by and obtainable from a single source (ETS).

The seven factors requiring new marker tests for this reason are as follows: (1) associational fluency, (2) expressional fluency, (3) originality, (4) semantic redefinition, (5) sensitivity to problems, (6) figural flexibility, and (7) semantic flexibility. The literature relevant to each factor was reviewed (Ekstrom, 1973). Definitions of the factors and hypotheses about the types of tests that would best mark them were developed.

Factors and Proposed Reference Tests

In this section a brief definition of each factor is presented along with reference to the literature that substantiates it. Then the marker tests developed for these factors are listed. The seven factors are, arbitrarily, numbered from 1 to 7 and the several factor-referenced tests are given serial numbers following the factor number. Thus, Test 32 is the second test (Cartoon Captions) intended to mark Factor 3 (Originality). For ready reference, following is a list of the seven factors studied in this report:

No.	Symbol	Factor Name
1	FA	Fluency, Associational
2	FE	Fluency, Expressional
3	O	Originality
4	SR	Semantic Redefinition
5	SP	Sensitivity to Problems
6	XF	Flexibility, Figural
7	XS	Flexibility, Semantic

1. Associational Fluency Factor (FA) -- This was defined as "the ability to produce words from a restricted area of meaning." It was hypothesized that tests which required the subject to produce synonyms, antonyms, completions for figures of speech, or to provide several examples of objects in a given category would be appropriate markers of this factor. The tests developed are:

12 - Opposites Test. The subject is asked to write up to six antonyms for each of four words. Five minutes for each of 2 parts.

13 - Figures of Speech. The subject is asked to provide up to three words or phrases to complete each of five figures of speech. Five minutes for each of 2 parts.

14 - Examples. The subject is asked to write up to 12 examples of objects in each of four categories. Six minutes for each of 2 parts.

For the purposes of the field testing, the following associational fluency test from the 1963 edition of the Kit was also included:

11 - Controlled Associations. The subject is asked to write up to 12 synonyms for each of four words. Six minutes for each 2 parts.

Associational fluency tests have been included in a number of studies during the past decade (Bereiter, 1960; Cave, 1970; Christensen and Guilford, 1963; Guilford, Fulgosi and Hoepfner, 1970; Haag and David, 1969; Hoepfner and Guilford, 1965; Kropp and Stoker, 1966; Ohnmach et al., 1970; Reed, 1966; Taylor et al., 1967). However, many of these studies failed to obtain an associational fluency factor. The main reasons for this were underdetermination of the factors (which resulted in associational fluency tests loading with vocabulary tests instead of forming a separate factor) and the use of a Guilford test, Associations IV, as a marker for associational fluency. (Guilford now feels that this test is a better marker for originality.)

2. Expressional Fluency Factor (FE) -- This was defined as "the ability to think rapidly of appropriate wording or rephrasing for an idea." It was hypothesized that tests which required rewriting of a given idea would be the markers for this factor.

The literature shows a number of relatively recent studies which include an expressional fluency factor (Bereiter, 1960; Brown et al., 1966; Christensen and Guilford, 1963; Hoepfner and Guilford, 1965; Mullins, 1967; Taylor et al., 1967). However, the factor loadings in many of these studies were not as clear as would be desirable. In particular, Guilford's Simile Interpretation test failed to be a reliable marker for this factor. Two other studies (Kropp and Stoker, 1966; Reed, 1966) were unable to obtain an expressional fluency factor, perhaps because of an insufficient number of marker tests for the factor. There has been difficulty in replicating this Guilford factor. The tests which were developed are:

21 - Making Sentences. The subject is asked to make sentences of a specified length when the initial letter of some of the words is provided. Ten items in each of 2 parts of 5 minutes.

22 - Arranging Words. The subject is asked to write up to twenty different sentences using the same four words. Two parts of 5 minutes each.

23 - Rewriting. The subject is asked to rewrite each of three sentences in two different ways. Two parts of 5 minutes each

3. Originality Factor (O) -- This was defined as "the ability to produce unusual or clever verbal responses." The definition of this factor is now specific to the semantic area. Of course, other types of originality factors may exist involving symbolic or figural material. It was hypothesized that test stimuli which would allow a wide range of possible responses would be necessary to elicit this factor.

Studies which have included originality marker tests from the 1963 Kit include Brown et al., 1966; Hendricks et al., 1966; Hoepfner and Guilford, 1965; Hoepfner et al., 1970; Kropp and Stoker, 1965. In other studies of originality (Harvey et al., 1970; Madeius, 1967), there has been difficulty in differentiating between originality and fluency.

The tests developed are:

31 - Repartee. The subject is asked to rewrite a conversation to make it more interesting. Five items in each of 2 parts of 5 minutes.

32 - Cartoon Captions. The subject is asked to think of captions (up to 10) for each of 3 cartoons. Two parts of 7 minutes each.

33 - Story Continuations. The subject is asked to write two different endings for each of four short stories. Two parts of 7 minutes each.

34 - What Would Happen Test. The subject is asked to write up to 10 possible results or consequences for each of four situations. Two parts of 5 minutes each.

4. Semantic Redefinition Factor (SR) -- This was defined as "the ability to verbally describe a shift or change of function or use for an object or for part of an object." It was hypothesized that tests which require the subject to think of novel or unconventional uses for common objects would be the best markers of this factor. The tests developed for this factor are:

41 - Finding Useful Parts. The subject is asked to select the one of five objects which will best help to solve a problem. Ten items in each of 2 parts of 5 minutes.

42 - Combining Objects. The subject is asked to name two objects which, when used together, would fulfill a particular request. Ten items in each of 2 parts of 5 minutes.

43 - Substitute Uses. The subject is asked to think of a common object that could serve as a substitute for the given object or purpose. Ten items in each of 2 parts of 5 minutes.

Only a few studies in the past decade have included any of the marker tests for semantic redefinition (Adcock and Martin, 1971; Adcock and Webberly, 1971; Fleishman and Dusek, 1971; Kropp and Stoker, 1966; Reed, 1966). An insufficient number of tests to mark this factor was a problem in almost all of these studies. Consequently, it is impossible to determine whether their failure to obtain this factor is due to the tests or to the experimental design. Several studies from Guilford's laboratory (Brown et al., 1966; Dunham et al., 1966; Hendricks et al., 1969; Hoepfner and Guilford, 1965; Nihira et al., 1964) obtain a factor partly defined by these marker tests and usually interpreted as divergent production of semantic classes. Semantic redefinition may be a sub-factor of spontaneous flexibility or of a larger redefinition factor not restricted to the semantic domain.

5. Sensitivity to Problems Factor (SP) -- This was defined as "the ability to recognize practical problems." It was hypothesized that tests which require the subject to identify deficiencies in an object or situation would be good markers of this factor.

The tests developed are:

51 - Improving Things. The subject is asked to think of an innovation for each of 15 common objects. Two parts of 15 minutes each.

52 - Planning Tests. The subject is asked to point out a logical deficiency in each of five plans. Two parts of 7 minutes each.

53 - Improving Laws and Customs. The subject is asked to describe an improvement for each of 10 laws or customs. Two parts of 15 minutes each.

The past decade has yielded only four studies which attempted to find this factor (Hoepfner and Guilford, 1965; Hoepfner et al., 1968; Kropp and Stoker, 1966; Nasca, 1965). There is a suggestion that this factor as now measured may be confounded with expressional fluency.

6. Figural Felxibility Factor (XF) -- This was defined as "the ability to change set so as to meet the requirements of figural problems." It was hypothesized that tests which require the subject to think of a large variety of arrangements for a few figural elements would be the best markers of this factor. The tests which were developed for figural flexibility are:

61 - Toothpicks Test. The subject is asked to provide up to six different solutions for each of 5 problems requiring the arrangement of a number of toothpicks to form a number of squares. Two parts of 5 minutes each.

62 - Planning Patterns. The subject is asked to arrange a certain number of specified letters in a matrix of dots in up to 12 different patterns. Six items in each of 2 parts of 5 minutes.

63 - Storage Tests. The Subject is asked to arrange a given number of small boxes in a larger container in as many different ways as possible. Two parts of 3 minutes each.

Five studies in the past decade (Adcock and Martin, 1971; Bunderson, 1967; Hoepfner and Guilford, 1965; Hoffman et al., 1968; Kropp and Stoker, 1966) used two or more of the marker tests from the 1963 Kit. It appears that Guilford's Planning Air Maneuvers test is not a good marker for this factor, being more convergent than divergent in nature. The problem then remains as to whether this is a test-specific factor involving Match Problem-type measures or if it has some larger meaning.

7. Semantic Flexibility Factor (XS) -- This was defined as "the ability to produce diverse verbal responses that can be differentially categorized." The ability to change set to produce various classes of objects seems to be basic to this factor. The tests developed for marking this factor are:

71 - Making Groups. The subject is asked to combine three or more objects from a list of seven items into up to seven different groups and to provide a reason for each grouping. Two items in each of 2 parts of 5 minutes.

72 - Different Uses. The subject is asked to think of up to six different uses for four common objects. Score is based on number of changes of use, not on total number of responses. Two parts of 5 minutes each

73 - Listing Objects. The subject is asked to list all objects that might be found in a given location. Two scores were obtained; score is based on (1) the number of different classes of objects named, and (2) total number of responses. Two parts of 2 minutes each.

One or more of the semantic flexibility marker tests from the 1963 Kit have been used in studies by Adcock and Martin, 1971; Brown et al., 1966; Dunham et al., 1966; Haag and David, 1969; Hendricks et al., 1969; Hoepfner and

Guilford, 1965; Hoepfner et al., 1968; Holtz, 1971; Reed, 1966. A fairly clear semantic flexibility factor appears only in studies from Guilford's laboratory. It seems probable that the instructional set and scoring directions are critical in determining this factor. It may be closely related to semantic redefinition (factor 4).

Subjects and Experimental Design

The subjects were male Naval recruits being processed through the Navy Training Center at San Diego, California during the spring of 1972.[1] We recognized, of course, that the men may have been assigned to companies according to some measures of ability, and that the 3 or 4 companies tested on a particular day might be a biased sample of Naval recruits in general. For this reason, we tried to base our statistical analysis on as wide a sampling (i.e., on as many companies as possible.

The overall characteristics of the samples are useful in judging the potential variability in particular subgroups. There were 45 different companies, containing from 35-72 men with an average of 58 men per company. Either three or four companies were included in a day's testing, with an average number of men in the 14 samples of 187 (a low of 173 and a high of 204). As a basis for judging the representativeness of these samples, we looked at the performance of the men on the General Classification Test (GCT) consisting of 100 verbal analogy and sentence completion items, and on an Arithmetic Reasoning Test (ARI) involving 30 arithmetic reasoning items. The scores on these tests are expressed as Navy Standard Scores (NSS) with means of about 50 and standard deviations of about 10 for an unrestricted recruit population.

Some of the indicators are shown in Table 1. For all 45 companies combined.

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[1]The field test was accomplished with considerable support from Dr. Bernard Rimland and Dr. Edmund D. Thomas, Navy Personnel Research & Development Center. This assistance is gratefully acknowledged.

TABLE 1

Some Characteristics of Samples of Naval Recruits

Sample (day tested)	No. of Companies	N	GCT		ARI	
			M	S.D.	M	S.D.
1	4	193	54.2	9.6	51.4	8.5
2	3	182	54.7	9.8	52.4	8.1
3	3	183	53.2	9.1	51.4	8.3
4	3	181	54.1	8.5	51.3	8.8
5	4	188	53.9	10.2	51.1	8.7
6	3	185	53.6	10.8	51.5	8.7
7	3	187	53.5	10.6	50.6	9.5
8	3	189	53.3	10.5	50.1	8.3
9	3	189	53.6	9.8	50.4	7.7
10	3	173	51.2	10.3	50.0	8.4
11	3	193	51.3	9.8	49.1	7.7
12	4	175	52.1	10.7	49.8	8.0
13	3	204	52.4	10.4	50.2	8.9
14	3	195	52.3	11.3	50.0	8.3
Total	45	2,617	743.4	141.6	709.3	118.2
Mean		187	53.1	10.1	50.7	8.4

The GCT mean is 53.1 and the standard deviation is 10.1, showing a general ability level slightly above average of the population and a dispersion precisely the same as for the population. The 45 GCT means for the individual companies vary from 50 to 56 while the 14 means of the daily samples are even more restricted, as can be seen from Table 1. On the ARI the overall mean is 50.7 and the standard deviation is 8.4, while the individual company means have a low of 48.2 and a high of 53.1 with daily sample means between 49.1 and 52.4. These gross statistics indicate

that the sampling is probably representative of the Naval recruit population (at least for the time of this study).

It was not feasible, of course, to administer all 23 tests to all the cases. In order to keep the daily testing time at a reasonable level and in order to avoid the costly task of capturing the same subjects on different days, an experimental design was developed in which daily samples (from the general Naval-recruit population) were obtained for the administration of selected subsets of tests. Also, each test was given on several days (to different subjects) so that sampling biases would be minimized.

Table 2 shows the details of the experimental design. As a general rule, all the tests for a given factor were given as a set (an exception was the set of 3 tests for Factor 5, which were the longest tests and probably would not hold the interest of the subjects). Also, it was desirable to give tests bridging two factors to each sample. This provides for a test of the "separability" of factors, that is, whether two factors that are not uncorrelated are, nonetheless, independent.

It should be noted that a complete matrix of intercorrelations among all tests cannot be obtained; the intercorrelations and factor analyses, of course, are based only on tests taken by a common group of subjects. The number of subjects taking any one test ranges from a low of 350 to a high of 757; groups of subjects used in correlational analysis and factor analysis generally exceeded 600, with the maximum possible number of subjects used to compute each correlation.

Psychometric Properties of the Tests

The tests were hand scored according to criteria developed by the authors. (An abbridged version of the scoring criteria appears in the Appendix. Each score was checked at least once and discrepancies were resolved by one of the authors.

TABLE 2

Experimental Design: Order of Test Administration

Test	Days													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
11	1	7								4				5
12	2	6								5			5	
13	3	5								6			6	
14	4	4								7			4	
21	5		3									2		3
22	6		2									1		4
23	7		1									3		2
31			6	1							5	4		
32			5	2	3								1	
33			4	3	2								3	
34				4	1						2		2	
41						1	7	5				6		
42						2	6	4				5		
43						3	5	3				7		
51								2						1
52						7	4	1	5					
53					4				4					
61							1		2	2	7			
62							2		3	1	8			
63							3		1	3	6			
71		1		7		4					4			
72		2		6		5					1			
73		3		5		6					3			
Testing Time (min.)	74	68	68	72	68	68	70	74	70	70	70	70	70	72

Note: The numbers in the columns for each day represent the order in which the tests were administered.

Item response frequencies, mean scores, standard deviations, and reliability coefficients were obtained for each test.[2]

An item analysis was made for each test. It included the difficulty of each item and the item-test biserial correlation. Some summary statistics of these item analyses are presented in Table 3.

For each item the percentage of subjects attempting an item who received credit for that item was determined. The range of these difficulty measures for each test appears in the table. It should be noted that on some types of divergent production items, especially those where quantity rather than quality of responses is important, a large proportion of subjects were able to make at least one response for each stimulus. For example, between 89% and 96% of the subjects were able to produce at least one acceptable synonym for each work in the Controlled Associations Test (11). This table also shows the range of item correlations with total test score. In general, it seems advisable to drop items which correlate less than .40 with total score. However, before that is done, one should investigate other reasons for low correlations, such as unclear directions or too few practice items. Under such circumstances only those subjects who understand the task would proceed beyond the first few items on a test. Feedback from test administrators is helpful in detecting these weaknesses. Eleven of the 23 tests had no items which correlate less than .40 with total test score.

Some summary test statistics are shown in Table 4. In addition to counts of items and ranges of scores, there are given the mean scores, the standard

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[2]The authors express their thanks to Henrietta Gallagher and her staff for the test scoring and to David Kirk for his work in expediting the data analysis.

TABLE 3

Item Statistics

Test Number	Number of Items	Item Difficulties	Item Correlations with Test Score
11	8	89 - 96	.63 - .71
12	8	82 - 100	.61 - .72
13	10	71 - 99	.53 - .69
14	8	83 - 100	.56 - .76
21	20	14 - 88	.26 - .63
22	2	93 - 98	.87 - .88
23	12	29 - 81	.40 - .67
31	20	81 - 94	.31 - .64
32	6	92 - 98	.58 - .68
33	16	81 - 96	.24 - .61
34	8	67 - 98	.25 - .60
41	20	27 - 95	.19 - .62
42	20	23 - 84	.33 - .61
43	20	38 - 89	.26 - .58
51	30	45 - 85	.27 - .50
52	10	11 - 78	.34 - .56
53	20	15 - 83	.22 - .58
61	10	20 - 93	.24 - .66
62	12	18 - 89	.10 - .60
63	2	37 - 40	.82 - .94
71	4	80 - 99	.58 - .71
72	8	20 - 90	.49 - .69
73	2	98 - 100	.71 - .89

deviations, the Spearman-Brown reliability (based on the correlation between the two parts of each test) and alpha reliability. Just as a reminder, the coefficient α for any test t is given by:

$$\alpha = \frac{n}{n-1}\left(1 - \sum_{i=1}^{n} V_i/V_t\right)$$

where n = number of items in test t,

V_i = variance of item i,

V_t = variance of test t.

It became apparent from a review of the test data at this point that there were several difficulties; test 14 was too easy for most subjects while test 63 was too difficult for many, the directions for test 62 were not understood by most subjects, and tests which included more than one page per part confused some of the less able subjects. Despite these problems, it was decided to retain all tests and all items for the initial factor analysis. After the preliminary analysis, tests 32 and 62 were dropped.

Factor Analyses

Table 5 shows the intercorrelations among the tests, where each correlation is based on the maximum number of cases taking the particular pair of tests. Except for the correlations involving tests 51 and 53, all correlations are based on more than 600 subjects and on samples obtained on more than one day.

It was expected that the highest correlations would occur among tests for the same factor with slightly lower correlations among tests for factors hypothesized to combine into a single higher-order factor (such as fluency or flexibility), and that the lowest correlations would occur among unrelated factors. A quick scanning of Table 5 discloses the fact that these conjectures hold up, by and large. An immediate exception to be noted is Test 62 which

TABLE 4

Test Statistics

Test	No. Cases N	No. Items n	Max. Possible Score	Obtained Scores Max	Min	Mean	S.D.	Reliability r_{12}	α
11	741	8	96	79	3	24.0	10.0	.82	.83
12	731	8	48	48	3	25.2	8.3	.82	.82
13	746	10	30	30	2	20.0	5.7	.77	.81
14	752	8	96	96	22	79.4	15.2	.88	.82
21	722	20	20	20	1	10.1	3.7	.77	.80
22	697	2	44	14	1	5.1	2.3	.68	.68
23	728	6*	24	19	0	5.5	2.9	.72	.62
31	710	10†	40	38	2	14.5	5.7	.80	.84
32	728	6	120	34	1	10.6	5.7	.62	.69
33	742	8#	32	27	2	12.4	4.7	.78	.76
34	757	8	80	28	1	11.2	4.6	.38	.52
41	734	20	20	19	1	12.1	3.6	.71	.73
42	710	20	40	38	4	19.4	7.1	.80	.80
43	697	20	20	20	1	14.4	4.0	.72	.81
51	352	30	30	29	1	12.5	5.6	.81	.80
52	719	10	10	10	0	4.2	2.1	.61	.62
53	350	20	20	19	0	8.9	4.2	.74	.79
61	733	10	60	20	0	6.1	3.7	.67	.53
62	625	12	144	60	0	12.7	9.3	-.06	.49
63	675	2	40	9	0	1.3	1.7	.73	.67
71	657	4	80	22	1	10.9	3.8	.68	.60
72	719	8	48	40	1	13.7	6.2	.78	.76
73	736	2	92	59	9	39.9	9.3	.73	.75

*Test 23 calls for two responses to each of six stimuli and is treated as a 12-item test.

†Test 31 calls for two responses to each of 10 pairs of stimuli and is treated as a 20-item test, with a score of up to two points for each of these items.

#Test 33 calls for two responses to each of 8 stimuli and is treated as a 16-item test, with a score of up to two points for each of these items.

TABLE 5

Intercorrelations of Tests

Test	11	12	13	14	21	22	23	31	32	33	34	41	42	43	51	52	53	61	62	63	71	72	73
11	1.00	.64	.48	.45	.40	.44	.42								.23			.24	.14	.08	.24	.40	.43
12	.64	1.00	.51	.63	.48	.47	.47		.38	.51	.38							.27	.19	.20	.48	.46	.58
13	.48	.51	1.00	.49	.43	.45	.37		.33	.49	.27							.07	.18	-.14	.24	.41	.48
14	.45	.63	.49	1.00	.53	.54	.53		.39	.60	.55							.36	.12	.27	.38	.46	.70
21					1.00	.55	.53	.51	.28	.56		.33	.48	.40	.23								
22					.55	1.00	.48	.50	.30	.50		.30	.38	.48	.34								
23					.53	.48	1.00	.45	.38	.50		.40	.61	.47	.27								
31								1.00	.43	.53	.49	.29	.46	.37				.27	.00	.21	.42	.47	.52
32								.43	1.00	.55	.44						.31				.18	.41	.35
33								.53	.55	1.00	.53						.31				.36	.48	.41
34								.49	.44	.53	1.00						.42	.29	.13	.29	.52	.53	.60
41												1.00	.49	.46	.38	.40		.31	-.07	.35	.37	.34	.36
42												.49	1.00	.57	.49	.44		.40	.12	.41	.56	.55	.62
43												.46	.57	1.00	.51	.46		.33	-.01	.40	.42	.48	.54
51															1.00	.36							
52															.36	1.00	.50	.37	.00	.41	.33	.30	.32
53																.50	1.00	.18	-.04	.20			
61																		1.00	.18	.39	.26	.26	.26
62																		.18	1.00	.13	.02	.10	.04
63																		.39	.13	1.00	.22	.29	.16
71																					1.00	.47	.37
72																					.47	1.00	.49
73																					.37	.49	1.00

just doesn't correlate much with any of the other tests--no doubt due to its unreliability, as pointed out above. This certainly confirms the earlier decision to drop Test 62. Also troublesome--insofar as being simple markers of particular factors--are Tests 14, 31, 33, 34, 42, 71, 72, and 73, which have as large or larger correlations with tests outside their respective groups as within. This points to the need for continued work on trying to improve these tests as measures of a single factor, or to the recognition that the factors, indeed, are not independent. Of course, the factor analyses will make these general observations more explicit.

The Minres method was used to obtain the direct factor analyses, and after determining that the fit was adequate, derived orthogonal factors and oblique factors were obtained by Varimax and Oblimin rotations, respectively. Because of the constraints which the testing situation imposed on the sampling plan, it was not possible to obtain a single solution for the entire group of tests. Instead, several two and three factor solutions wer obtained, which are shown in the remaining tables. In each table the several tests are shown that were hypothesized as markers for the particular factors. The intended factors are named in the titles of the tables and also in the factor solutions, whether the match is very good or not. When the hypothesized factors are inexplicable from the solution, they are so indicated.

Tables 6, 7, and 8 contain the major factor analyses for the tests designed to mark the associational fluency factor. As can be seen from these results, associational fluency can be clearly differentiated from expressional fluency, originality, and adaptive flexibility. It does not seem possible to separate semantic flexibility from associational fluency on the basis of these tests. This may be because individuals who can produce a wide range of associations

Table 6

Associational Fluency (FA) and Expressional Fluency (FE) Factors

Test	Varimax Factors		Oblimin Factors		h^2
	FA	FE	FA	FE	
11 Controlled Associations	.65	.32	.70	.03	.52
12 Opposites Test	.81	.34	.91	-.04	.77
13 Figures of Speech	.48	.42	.39	.28	.41
14 Examples	.49	.58	.29	.51	.58
21 Making Sentences	.28	.70	.08	.82	.57
22 Arranging Words	.33	.64	-.03	.70	.52
23 Rewriting	.32	.60	-.04	.65	.46
Variance	1.84	1.99	Factor Correlations		3.83
Factor					
FA			1.00	-.77	
FE				1.00	

Table 7

Associational Fluency (FA) and Originality (O) Factors

Test	Varimax Factors		Oblimin Factors		h^2
	FA	O	FA	O	
12 Opposites Test	.76	.28	.87	-.08	.66
13 Figures of Speech	.56	.29	.59	.05	.40
14 Examples	.63	.49	.56	.29	.64
32 Cartoon Caption	.25	.59	-.03	.66	.41
33 Story Continuations	.43	.71	.15	.71	.68
34 What Would Happen	.27	.63	-.01	.69	.47
Variance	1.61	1.65	Factor Correlations		3.26
Factor					
FA			1.00	.75	
O				1.00	

Table 8

Associational Fluency (FA), Figural Flexibility (XF), and Semantic Flexibility (XS) Factors

Test	2 Factor Solutions					3 Factor Solutions						
	Varimax		Oblimin		h^2	Varimax			Oblimin			h^2
	FA (+XS)	XF	FA (+XS)	XF		FA (+XS)	XF	?	FA (+XS)	XF	?	
11 Controlled Associations	.65	.10	.67	-.07	.43	.65	.09	.19	.69	-.09	.01	.47
12 Opposites Tests	.76	.25	.79	.05	.65	.73	.23	.27	.75	.02	.09	.67
13 Figures of Speech	.76	-.17	.79	-.37	.61	.67	-.20	.32	.59	-.39	.20	.59
14 Examples	.71	.36	.73	.17	.64	.41	.29	.87	-.08	.09	1.03	1.00
61 Toothpicks Test	.21	.51	.21	.46	.30	.17	.49	.16	.15	.43	.14	.30
63 Storage Test	-.01	.76	-.02	.77	.58	-.01	.75	.06	.01	.74	.06	.57
71 Making Groups	.43	.34	.44	.23	.30	.44	.34	.12	.49	.22	-.01	.33
72 Different Uses	.56	.35	.58	.20	.44	.56	.43	.18	.61	.19	.02	.46
73 Listing Objects	.69	.25	.71	.07	.54	.52	.19	.50	.31	.01	.49	.55
Variance	3.11	1.37			4.48	2.39	1.29	1.27				4.94
Factor			Factor Correlations						Factor Correlations			
FA (+XS)			1.00	.27					1.00	.20	.71	
XF				1.00						1.00	.20	
?											1.00	

for a word may be able to do so if they are more flexible in their definition of the word. Bereiter (1960) also found a factor which included tests of associational fluency and semantic flexibility. He suggested that this might be a personality factor arising from "differences in looseness or rigor with which Ss interpret the given restrictions."

The Controlled Associations and Opposites tests appear to be the best markers for this factor. The Figures of Speech test needs to be revised to reduce its variance on expressional fluency. The Examples test clearly is a complex one--actually loading somewhat more on expressional fluency than on associational fluency. It's problems may be related to the test's level of difficulty, or it may be a better measure of the semantic flexibility factor.

Table 9

Expressional Fluency (FE) and Originality (O) Factors

Test	Varimax Factors		Oblimin Factors		h^2
	FE	O	FE	O	
21 Making Sentences	.78	.11	.84	-.13	.62
22 Arranging Words	.70	.14	.74	-.07	.51
23 Rewriting	.63	.24	.65	.05	.45
31 Repartee	.62	.30	.62	.12	.47
32 Cartoon Captions	.22	.97	.04	.98	1.00
33 Story Continuations	.64	.41	.63	.24	.58
Variance	2.34	1.29	Factor Correlations		3.63
Factor					
FE			1.00	.46	
O				1.00	

The expressional fluency tests appear in tables 6, 9, 10 and 11. This factor seems to be clearly differentiated from associational fluency, and from semantic redefinition. It does not appear possible to separate expressional fluency and originality.

The question arises, then, as to whether the factor is expressional fluency or originality; the analysis is not very helpful in this respect. However, it could be argued that our scoring criteria for an "original" response were not sufficiently restrictive. A more exacting criterion for original responses might allow these factors to be separated. Also, other researchers (see Ekstrom, 1973) have argued that an adequate level of competency in the expressional medium is necessary before creativity in that medium is obtained. It may be that these subjects were not sufficiently fluent to demonstrate semantic originality. For these reasons, it seems more likely that this is an expressional fluency factor than an originality factor.

In view of the difficulties which other researchers have had in obtaining the expressional fluency factor--for example, Kropp and Stoker (1966) or Reed (1966)--these results are encouraging. However, there still appears to be considerable difficulty in selecting good marker tests and in defining this ability. The Making Sentences and Arranging Words tests, which seem to be the best markers for this factor, do not really measure "the ability to think of appropriate wording or rephrasing for an idea." They may be more accurately described as measuring a form of ideational fluency in which it is necessary to think of many different topics instead of many ideas about a single topic. Perhaps the differentiation between breadth and depth of ideas is important here. The Rewriting test has considerable variance on the semantic redefinition factor.

Table 10

Expressional Fluency (FE), Originality (O), and Semantic Redefinition (SR) Factors

Test	2 Factor Solutions					3 Factor Solutions						
	Varimax		Oblimin		h^2	Varimax			Oblimin			h^2
	FE	SR	FE	SR		FE	SR-1	SR-2	FE	SR-2	SR-1	
21 Making Sentences	.68	.32	.73	.03	.56	.66	.33	.13	.73	-.06	.10	.57
22 Arranging Words	.70	.26	.79	-.06	.56	.71	.12	.31	.78	.16	-.20	.62
23 Rewriting	.49	.54	.35	.44	.54	.48	.53	.20	.45	.06	.36	.55
31 Repartee	.59	.31	.62	.07	.45	.58	.31	.14	.62	-.03	.11	.45
41 Finding Useful Parts	.21	.57	-.05	.64	.37	.21	.43	.32	.09	.29	.31	.33
42 Combining Objects	.32	.77	-.02	.85	.70	.28	.79	.28	.11	.19	.71	.79
43 Substitute Uses	.36	.60	.13	.60	.49	.26	.34	.81	.01	.88	.05	.84
Variance	1.82	1.84	Factor		3.67	1.70	1.42	1.01	Factor			4.14
Factor			Correlations						Correlations			
FE			1.00	.74					1.00	.59	.53	
SR-2				1.00						1.00	.47	
SR-1											1.00	

Table 11

Expressional Fluency (FE), Semantic Redefinition (SR), and Sensitivity to Problems (SP) Factors

Test	Varimax Factors		Oblimin Factors		h^2
	FE	SR+SP	FE	SR+SP	
21 Making Sentences	.78	.18	.86	-.10	.64
22 Arranging Words	.58	.31	.56	.15	.44
23 Rewriting	.64	.37	.60	.19	.54
41 Finding Useful Parts	.30	.52	.14	.51	.36
42 Combining Objects	.47	.63	.29	.57	.61
43 Substitute Uses	.37	.67	.16	.66	.59
51 Improving Things	.13	.68	-.13	.76	.47
Variance	1.82	1.84	Factor Correlations		3.66
Factor					
FE			1.00	.62	
SR+SP				1.00	

Table 12

Originality (O) and Semantic Flexibility (XS) Factors

Test	Varimax Factors		Oblimin Factors		h^2
	O+XS	XS	O+XS	XS	
31 Repartee	.67	.22	.71	-.00	.50
33 Story Continuations	.66	.18	.70	-.05	.46
34 What Would Happen	.71	.32	.72	.10	.61
71 Making Groups	.30	.95	.02	.99	1.00
72 Different	.63	.29	.64	.09	.48
73 Listing Objects	.69	.18	.74	-.06	.51
Variance	2.35	1.21	Factor Correlations		3.56
Factor					
O+XS			1.00	.57	
XS				1.00	

Table 13

Originality (O), Figural Flexibility (XF), and Semantic Flexibility (XS) Factors

Test	2 Factor Solutions					3 Factor Solutions						
	Varimax		Oblimin		h^2	Varimax			Oblimin			h^2
	O+XS	XF	O+XS	XF		O+XS	XF	XS	O+XS	XF	XS	
31 Repartee	.66	.15	.68	-.02	.46	.55	.14	.33	.52	.01	.20	.43
34 What Would Happen	.76	.20	.78	.01	.62	.65	.19	.36	.62	.04	.19	.59
61 Toothpicks	.30	.36	.26	.30	.22	.29	.35	.13	.22	.31	.04	.22
63 Storage Test	.10	.99	-.07	1.03	1.00	.12	.99	.04	-.08	1.04	-.03	1.00
71 Making Groups	.60	.17	.61	.32	.39	.69	.13	.11	.79	-.03	-.12	.50
72 Different Uses	.66	.22	.67	.06	.49	.60	.20	.27	.61	.06	.10	.49
73 Listing Objects	.72	.09	.76	-.09	.52	.37	.08	.92	.05	-.01	.97	1.00
Variance	2.44	1.27	Factor Correlations		3.71	1.81	1.22	1.20	Factor Correlations			4.23
Factor												
O+XS			1.00	.40					1.00	.42	.61	
XF				1.00						1.00	.23	
XS											1.00	

Tests designed to mark the originality factor can be found in tables 9, 10, 12, and 13. One of these tests, the Cartoon Captions test, was dropped from the analysis because it appears to measure something different from the other three originality tests. Whether this might be a behavioral relations factor or whether it simply separates out because of the non-verbal stimuli is impossible to determine from these data.

This factor appears to be differentiated from associational fluency, and from figural flexibility. However, it does not seem possible to separate it from expressional fluency or from semantic flexibility. Other researchers (Ward, 1968; Fee, 1969; Cropley and Maslany, 1969; Murphy, 1973) have also found it impossible to obtain separate factors for the number of responses (fluency) and unique responses (originality) on creativity tests, so these findings are not suprising. Their findings, along with the results of the present study, suggest that originality is not a sufficiently well established factor for inclusion in the revised kit.

The tests intended to mark the semantic redefinition factor are analyzed in tables 10, 11, and 14. While semantic redefinition is clearly differentiated from expressional fluency and from figural flexibility, there is a definite question as to whether or not it is possible to separate it from semantic flexibility. Other studies (Adcock and Martin, 1971; Adcock and Webberley, 1971; Fleishman and Dusek, 1971; Kropp and Stoker, 1966; and Reed, 1966) have also had difficulty in obtaining this factor. In both of the Adcock studies semantic redefinition and semantic flexibility tests tended to combine on a single factor. In the earlier literature review (Ekstrom, 1973), it was pointed out that there seemed to be little basis for differentiating between them if the "spontaneous" element was not a critical part of the latter factor. It seems increasingly likely that there is a single factor which includes both of these abilities.

Table 14

Semantic Redefinition (SR), Sensitivity to Problems (SP), Figural Flexibility (XF), and Semantic Flexibility (XF) Factors

Test	2 Factor Solutions					3 Factor Solutions							4 Factor Solutions								
	Varimax		Oblimin		h^2	Varimax			Oblimin			h^2	Varimax				Oblimin				h^2
	SR+XS	XF+SP	SR+XS	XF+SP		XF+SP	XS_3	XS	XF+SP	XS_3	XS		XS_3	XS	XF	SP	XS_3	XS	XF	SP	
41 Finding Useful Parts	.42	.44	.33	.35	.37	.47	.25	.30	.43	.11	.16	.37	.28	.28	.25	.39	.13	.15	.10	.35	.37
42 Combining Objects	.74	.41	.73	.17	.72	.46	.47	.51	.32	.31	.36	.69	.53	.49	.30	.30	.39	.36	.20	.08	.70
43 Substitute Uses	.59	.44	.55	.26	.54	.49	.43	.33	.41	.31	.15	.53	.47	.30	.27	.39	.37	.11	.12	.29	.54
52 Planning Test	.31	.55	.17	.52	.41	.57	.19	.22	.58	.05	.06	.41	.18	.18	.26	.62	-.00	.00	.00	.71	.52
61 Toothpicks Test	.23	.51	.09	.50	.31	.51	.14	.17	.53	.02	.02	.31	.17	.18	.34	.33	.04	.06	.25	.27	.28
63 Storage Test	.13	.70	-.10	.77	.50	.69	.05	.11	.79	-.10	-.09	.49	.08	.10	.80	.22	-.06	-.05	.87	.04	.73
71 Making Groups	.56	.26	.57	.06	.38	.21	.18	.75	-.02	-.07	.85	.64	.21	.72	.08	.23	-.06	.80	-.06	.07	.62
72 Different Uses	.63	.24	.66	.02	.45	.28	.38	.46	.14	.25	.38	.43	.44	.45	.21	.14	.33	.39	.17	-.08	.46
73 Listing Objects	.74	.14	.83	-.16	.56	.15	.93	.23	-.04	1.01	-.04	.93	.85	.20	.03	.19	.92	-.05	-.08	.05	.80
Variance	2.49	1.75	Factor Correlations		4.24	1.87	1.55	1.36	Factor Correlations			4.80	1.60	1.25	1.10	1.07	Factor Correlations				5.02
Factor																					
SR+XS			1.00	.60																	
XF+SP				1.00					1.00	.46	.58										
XS_3										1.00	.59						1.00	.60	.35	.50	
XS											1.00							1.00	.41	.56	
XF																			1.00	.63	
SP																				1.00	

It is difficult to make any decisions about the sensitivity to problems factor from the current analysis. The correlations among pairs of these tests are not high (.36 and .50). Because of the length of these tests, it was not possible to administer all three of them together. When one of the tests for this factor appeared in a factor analysis (Tables 11 and 14), there was a tendency for it to combine with semantic redefinition or flexibility tests. However, until further research is done with these tests it will be impossible to reach any definite conclusion.

As was mentioned earlier, a large number of the subjects were unable to understand the directions for one of the three tests of figural flexibility, the Planning Patterns test. This test was dropped from the analysis as it

Table 15

Figural (XF) and Semantic (XS) Flexibility Factors

Test	Varimax Factors		Oblimin Factors		h^2
	XF	XS	XF	XS	
61 Toothpicks Test	.36	.31	.30	.27	.23
63 Storage Tests	.99	.12	1.03	-.07	1.00
71 Making Groups	.16	.59	.02	.60	.37
72 Different Uses	.19	.73	.02	.74	.57
73 Listing Objects	.10	.64	-.06	.67	.42
Variance	1.19	1.39	Factor Correlations		2.58
Factor					
XF			1.00	.41	
XS				1.00	

became clear that the scores were meaningless. Tables 8, 13, 14, and 15 include the remaining figural flexibility tests. This factor appears to be clearly differentiated from most of the other factors (associational fluency, originality, semantic flexibility) in this analysis, probably because of the figural rather than verbal item content. However, there does appear to be some overlap between the semantic redefinition and figural flexibility factors in Table 14. Cattell (1971) has suggested the existence of a higher-order Flexibility vs. Firmness personality factor which might explain some of the variance involved in responding to divergent production tests.

The semantic flexibility factor is included in Tables 8, 12, 13, 14, and 15. While it is possible to differentiate between semantic flexibility and figural flexibility, it is more difficult to decide if the associational fluency and semantic redefinition factors are really measuring something different from semantic flexibility. As was mentioned in the review of the literature (Ekstrom, 1973), researchers outside of Guilford's laboratory, such as Adcock and Martin (1971), Reed (1966), Holtz (1971), and Haag and David (1969), have experienced difficulty in finding the semantic flexibility factor. Attempts to separate the number of responses (fluency) and the number of different classes or set changes (flexibility)--by obtaining separate counts of each of these--were unsuccessful. The two counts correlate .79 and consistently load on the same factor.

Conclusions

It seems likely that the divergent production factors which are being studied here were too narrowly conceptualized when they were studied in Guilford's laboratory. One possible approach is to consider them as three larger factors:

1) Fluency of Association which includes both associational fluency and semantic redefinition and, possibly, semantic flexibility.
2) Fluency of Expression which includes both expressional fluency and originality and, possibly, semantic flexibility.

3) Fluency of Figures which includes figural flexibility and may also encompass the figural ideational fluency factor which was not a part of this study.

However, this approach seems to be describing these factors too broadly. The following factors appeared fairly clearly: (1) associational fluency, which should probably be reconceptualized to include the grouping types of responses (requiring the recognition of common or associational properties) found in the Making Groups and Different Uses tests, (2) expressional fluency, which should probably be redefined as the ability to think rapidly of word groups or phrases, (3) object flexibility, which should probably be conceptualized as the kind of mental set changing necessary to think of different uses for objects, and, less clearly, (4) figural flexibility, which may simply be the figural form of the object flexibility factor. There is some evidence to suggest that the kinds of mental processes required in listing the specific components of a class or in listing objects that might be found together may constitute a currently undefined factor or be part of object flexibility. There was insufficient evidence to reach any conclusions about the sensitivity to problems factor. The semantic originality factor seems to be a combination of expressional fluency and the object flexibility factor.

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APPENDIX

Test Directions and Scoring Guides

11. CONTROLLED ASSOCIATIONS TEST

Directions

When you are writing, it is often necessary to think of several different words having the same meaning or similar meanings, so that you do not have to repeat one word again and again. In this test you will be asked to think of words having meanings which are the same as or similar to a given word. The given words will be ones that are well known to you.

For example, if the word were short, you would write at least some of the words written below:

short:	brief	abbreviated	concise	momentary
	little	limited	deficient	abrupt
	petite	crisp	compact	curtailed

Now try this one. You probably will not be able to fill in all the spaces, but write as many words as you can think of.

weak:	_____	_____	_____	_____
	_____	_____	_____	_____

Your score will be the number of correct words that you write.

You will have 6 minutes for each of the two parts of this test. Each part has one page. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

Scoring

A list of synonyms was prepared using Webster's Dictionary of Synonyms and several other dictionaries. A review of several samples revealed that all responses did occur on this list of synonyms. Consequently, the final score was based on the total number of responses.

12. OPPOSITES TEST

Directions

In this test you will be asked to think of words which are the opposite or nearly the opposite in meaning to a given word.

For example, if the word were EASY, you might think of some of the words written below.

EASY:	hard	arduous
	difficult	exacting
	complicated	burdensome

Now try to think of some words which mean about the opposite of the word given below. You may not be able to fill in all of the spaces, but write as many words as you can (up to six) which are opposite in meaning to the word given.

ACCEPT:	_____	_____
	_____	_____
	_____	_____

Some of the words which you might have written are decline, deny, disregard, neglect, reject, and refuse.

Your score on this test will be the number of correct words that you write.

You will have 5 minutes for each of the two parts of this test. Each part has one page with four given words. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

Scoring

A list of antonyms was developed from the same sources used for FA-1. Again, a review of several samples indicated that all responses were acceptable antonyms. Consequently, the final score was based on the total number of responses.

13. FIGURES OF SPEECH

Directions

In this test you will be asked to think of words or phrases that could be used in making figures of speech which compare one object with another. For example:

She was as pale as: death

(a) sheet

(a) wax doll

Now try to think of some words or phrases that could complete the figure of speech given below. You may not be able to fill in all of the spaces, but write as many words as you can. The word a or an can be used in addition to the comparison word whenever you think it is necessary.

The jewels sparkled like: _____

_____

_____

You might have chosen words like fireflys, twinkling stars, or dew drops in the sun to complete this figure of speech.

Your score on this test will be the number of correct words or phrases which you write.

You will have 5 minutes for each of the two parts of this test. Each part has one page with five sentences to complete. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

Scoring

A list of examples of acceptable responses was developed from a review of a sample of the tests. In general, any response commonly associated with the characteristic being referred to was considered acceptable. All cases of conflict were resolved by the test author. Score was the number of acceptable responses.

14. EXAMPLES

Directions

This is a test of your fluency in naming things that fall into a given class. You will be given some general headings for things and will be asked to name as many things as you can (up to 12) that belong under that heading.

For example, if the heading were FRUITS, you would write at least some of the words (or phrases) written below:

FRUITS:	apple	grape	plum	blueberry
	pear	orange	crab apple	cranberry
	water melon	grapefruit	raspberry	lemon

Now try this one. You may not be able to fill in all the spaces, but see how many you can think of:

COLORS:	_____	_____	_____	_____
	_____	_____	_____	_____
	_____	_____	_____	_____

Your score will be the number of correct words or phrases that you write.

You will have 6 minutes for each of the two parts of this test. Each part has one page with four headings. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

Scoring

A list of examples of acceptable responses was developed from a review of a sample of the tests. Either generic terms for a subgroup within the category or specific terms were allowed but both were not credited in the same list. (For example, credit was not given for coat if raincoat, sport jacket, and topcoat were also listed). Score was the number of acceptable responses.

21. MAKING SENTENCES

Directions

In this test you will be asked to write sentences containing words that begin with specified letters. You will also be told what the length of the sentence is to be. The sentences can be either sensible or foolish but they must be understandable and not just a group of unrelated words.

Each item will consist of a group of asterisks and letters followed by blanks. When you write the sentence you must begin a word with each of the letters that is given; where there is an asterisk you may use any word you wish. Each sentence must use the letters and asterisks in the order that they are given. For example:

E_____*_____R_____T_____*_____.

E very * boy R ead T he * book .

You are to look at each group of letters and asterisks and write down whatever sentence you think of first. There are no restrictions on the words you may use or on their length except that proper names, such as the names of people or places, may not be used. Abbreviations may not be used either but you may use contractions such as aren't or we'll.

Now try this sample:

T_____*_____W_____W_____*_____.

Sentences like "This is what we need." or "Termites eat wooden watches frequently." are correct. A sentence like "This is Wanda Witch's birthday." is incorrect because it uses a proper name.

Your score will be the number of acceptable sentences which you write.

You will have 5 minutes for each of the two parts of this test. Each part has one page with 10 sentences. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

Scoring

Examples of acceptable responses were developed from a review of a sample of the tests. Any complete sentence or phrase was credited unless it contained proper names (of people, places, etc.) or abbreviations. Sentence fragments were not credited. Score was the number of acceptable sentences.

22. ARRANGING WORDS

Directions

In this test you will be asked to write as many sentences as you can using four specified words.

For example:

TAKE FEW LAND LITTLE

1. Few crops take little land.
2. A few little boats take supplies to land.
3. Take a few little boys with you to see the plane land.

All four words are used in each sentence. The words must be used in the form that is given; for example, you cannot use "taking" or took" instead of take. Notice that the sentences may be any length. All sentences must differ from one another by more than merely one or two changed words, such as different pronouns or adjectives.

Now try this example. Remember to number each new sentence as was done in the example above.

WRITE WORDS LONG OFTEN

Your score will be the number of different sentences that you write.

You will have 5 minutes for each of the two parts of this test. Each part has one page. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

Scoring

Sentences were first checked to be sure that each of the required words was used. Sentences which were alike except for one word were not credited nor were sentences using a different form of any of the required words. The score was the number of correct sentences.

23. REWRITING

Directions

In writing it is often necessary to rephrase a sentence differently from the way in which the idea was originally stated. You will be asked to rewrite sentences in this way for this test.

For example:

"In response to the teacher's question, a forest of hands shot up."

Might be rewritten as:

(a) "When the teacher asked a question, almost every hand was raised to answer it."

Can you think of another way to say the same thing?

(b) _____

_____

_____

Each of the items in this test will consist of a sentence which you are to rewrite. Try to write two new sentences for each sentence given. You should try to use different words and different sentence constructions. Do not change the meaning of the original sentence.

Your score will be the number of acceptable sentences which you write.

You will have 5 minutes for each of the two parts of this test. Each part has one page with three sentences. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

Scoring

Because of marked differences in the quality of responses, this test was scored giving two points credit for sentences which were very much changed from the stimulus and one point credit for minor changes. Examples of responses of both types were developed from a review of a sample of tests. Scoring conflicts were resolved by the test author. Final score was the weighted sum for the responses.

31. REPARTEE

Directions

This test represents one way to show your originality. Some conversations are dull; some are interesting, original, or entertaining. Each item in this test presents a dull conversation consisting of two questions and two answers. Your task is to improve the two answers so as to give the conversation some interest or some sparkle.

Sample item:

"Did you go to the party?"
"Yes, (it was fun) _____."
"Did you bring your friend?"
"Yes, (we danced together) _____."

You are to drop just the words in parentheses, and write down your own. Change the meaning as much as you like, but the words not in parentheses must remain in the conversation and must continue to make sense.

Suitable answers for the sample item above might be: "...but I didn't take part in the action." and "...he was playing ping-pong all of the time."

Your score on each item will be:

0 for a new pair of dull answers
1 for pepped up answers
2 for answers with a meaningful twist

You will have 5 minutes for each of the two parts of the test. Each part has one page with five items (10 answers to be rewritten). When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

Scoring

A weighted score was developed giving two points for responses with new ideas, puns, switches in meaning, humor, insight into social situations, or any clever, interesting or novel response; responses which were meaningful and more "pepped up" than the sample but which had only a modest change in meaning were given one point. Examples of acceptable responses in each category were developed by the test author from the review of a sample of tests. Final score was the weighted sum.

32. CARTOON CAPTION TEST

Directions

In this test you will be shown some cartoon pictures. You will be asked to write as many titles or captions as you think of for each cartoon. What you write could be what you think someone in the cartoon is saying or it could be a comment on human nature suggested by the cartoon. Try to make the captions that you write funny or clever.

Now look at this example:

1. Your extra punishment is more visits from your wife.
2. It started out as a meaningful involvement in community affairs.

Try to think of some more captions for this cartoon and write them on the lines above.

Your score for each item on this test will be:

Credit 0: For each caption that is not appropriate for the cartoon (such as "Let's to to the store" for the above cartoon) or for a caption that is not at all original (such as "How are you today?" for the above cartoon.
Credit 1: for each caption that is appropriate and
Credit 2: for each caption that is really clever and original.

You will have 7 minutes for each of the two parts to this test. Each part has three pages with one cartoon on each page. When you have finished Part 1, STOP.

Scoring

As for the preceeding test, a weighted score was developed giving two points for the most clever and original responses and one point for appropriate but less original responses. Examples of acceptable responses in each category were developed by the test author from a review of a sample of tests. Final score was the weighted sum.

33. STORY CONTINUATIONS

Directions

This will give you the opportunity to try out your imagination in thinking up different ways to continue stories. Each item gives a part of a story. You are to continue the story by writing another sentence or two. Do this in two different ways, A and B.

Here is an example:

It was dark that night, and, as I hurried toward home, I looked backward several times. When I was just a few steps from my house, I pulled the key out of my pocket. Then I suddenly stood still. The door was open.

A. _____

_____

B. _____

_____

Your two answers, A and B, must be different ideas, not merely changes in a word or two. For example, your answers might be:

A. There was my father pointing at the clock.

B. I thought I could see someone inside; so I ran up the road to a neighbors house, where I could telephone for the police.

Your score will be the number of sensible story continuations that you write.

You will have 7 minutes for each of the 2 parts of this test. Each part has the page with four items. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

Scoring

A weighted score was developed similar to that used for the two preceeding tests; the most unusual or original continuations received two points, those less creative but appropriate received one point. Examples of acceptable responses in each category were developed by the test author. Score was the weighted sum.

34. WHAT WOULD HAPPEN TEST

Directions

This is a test of your ability to think of what the consequences or results of a situation might be. You will be asked to think of as many different results as you can.

For example:

What would happen if people no longer needed or wanted to eat?

1. No more picnics
2. Stoves not needed
3. No need to diet
4. _____
5. _____

There are many more possible results that could have been written. Try to think of some others and write them on the lines above.

For each item in this test you will be asked to think of as many different results as you can that would happen if the described situation occurred. Your answers need not be complete sentences.

Your score will be the number of acceptable results which you list.

You will have 5 minutes for each of the two parts of this test. Each part has two pages with four items. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

Scoring

A list of acceptable responses was developed by the test author after reviewing a sample of the tests. Both obvious and less obvious consequences were credited. Score was the number of acceptable responses.

41. FINDING USEFUL PARTS

Directions

Ordinary objects are made up of parts that can be put to a multitude of uses that are not related to the object itself. This is a test of how cleverly you can think about the parts of objects as well as about the objects themselves.

Each problem indicates something you want to make or do. A part of one of 5 given objects will solve the problem. You are to circle the number of the object that has a part which will solve the problem.

Here is a sample item:

Problem: To look at a pimple on your forehead.

1.	2.	3.	4.	5.
pile of books	table cloth	broken down automobile	potted plant	rocking chair

The answer is "3", since an automobile is likely to have one or more rearview mirrors.

Your score on this test will be the number of correct responses which you give.

You will have 5 minutes for each of the two parts of this test. Each part has one page with 10 problems. When you have finished Part 1, STOP. Do not go on to Part 2 until you are asked to do so.

Scoring

A scoring key was used. Only one response was considered correct for each item. Score was total number of correct responses.

42. COMBINING OBJECTS

Directions

In this test you will use your practical resourcefulness in naming two objects that can be used together in order to make something or do something that is required. You will name objects usually found around specified locations. For example:

Request: Rub dirt off the inside of a small bottle.
Location: An ordinary house; bottle cleaners are not available.

_____ _____

For this problem you would write down "rag" and "pencil" or two similar objects, since you could wrap the rag around the pencil and insert it into the bottle.

Each item in the test will make a request and will indicate your location and the lack of some particular appropriate object. You are to name two objects that would usually be found in the given location and which can be used together to fulfill the request. Assume that you are allowed to prepare the objects with tools or equipment that is usually available in the given location.

Your score will be the number of correct responses which you give.

You will have 5 minutes for each of the two parts of this test. Each part has one page with 10 items. When you have finished Part 1, STOP. Do not go on to Part 2 until you are asked to do so.

Scoring

A list of acceptable objects was developed. Part credit (1 point) was allowed when only one of the two objects was mentioned. Score was the number of correct responses.

43. SUBSTITUTE USES

Directions

Sometimes you find yourself in a place where the object that you normally would use to perform a task is not available and it is necessary for you to find a substitute. For example, suppose you are at a baseball game on a very hot day. You have forgotten to bring a fan of any sort. What could you use instead to fan yourself? You might think of using the baseball program or a hat as a substitute for a fan.

In this test you will be asked to think of objects that can be used as substitutes. You will be asked to imagine yourself in a situation with certain surroundings and to name a common object that is likely to be found in this location and which can serve as a substitute for the named object or purpose.

Now try this example: Supposed you have been shipwrecked and are on a small raft with only your clothing, some food, some water, and some fishing equipment available. What one object might you use to make a small sail?

A shirt or a blouse would be correct answers. It would be incorrect to say a table cloth because it is not likely that there would be one available.

Your score on this test will be the number of acceptable answers which you give.

You will have 5 minutes for each of the two parts of this test. Each part has 10 items. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

Scoring

A list of objects which might be used as substitutes was developed. No credit was given for objects ordinarily used for the described purpose. Score was the number of acceptable responses.

51. IMPROVING THINGS

Directions

In this defective but changing world we hope people are trying to think of ways to improve it. In this test pretend you are a design engineer whose job is to think up new ideas for making or improving objects.

For each object named in the test, write down one new idea that might make the object better, or more useful, or more attractive in some way. Your answers should be specific, they should pertain to the object named, and they should not be something that is already true about the object. Do not be concerned about the technical details that might be needed. Your comments do not have to be in whole sentences.

Look at this example:

Electric razor _____

_____

Good answers might be: "Make it blunt or burn the ends of hairs so they won't regrow so fast." or "Make it give you a signal, like stopping its buzzing, when the skin it touches is already shaved as well as possible." Answers like "make it cheaper," "make it quiet," or "make it shave closer" are not good answers because they are too general and do not suggest a specific change. An answer like "make it run on a battery" is not a good answer because some shavers already do this.

If you cannot think of a suitable answer for one object, go on to the next.

Your score will be the number of suitable answers which you give.

You will have 15 minutes to work on each of the two parts of this test. Each part has one page which names 15 items. When you have finished Part 1, STOP. Do not go on to Part 2 until you are asked to do so.

Scoring

A list of acceptable improvements was developed. An improvement had to be specific to be credited. Score was the number of acceptable responses.

52. PLANNING TEST

Directions

In this test you will be asked to find what is wrong with a given plan or idea. You will read a short description of the plan. In each plan there is something wrong. You will be asked to tell what is wrong with the plan and why it will not work as it should.

For example:

The highway department is trying to decide on the best way to keep open the hilly mountain road leading to a ski resort. When there are snow storms the road gets very slippery and has many deep drifts. They plan to sand the road first to keep people from skidding and then to plow the road.

What is wrong with this plan?

_____

_____

You might have said something like "Plowing the road after it has been sanded will take off all the sand."

You do not have to suggest ways to improve the plan. Just tell what is wrong with the plan as described. Your answer does not have to be a complete sentence but it should be clear. It is important that you give enough details so that your reasons will be understood.

Your score on this test will be the number of items in which you describe the poor planning.

You will have 7 minutes for each of the two parts of this test. Each part has two pages with 5 items. When you finished Part 1, STOP. Do not go on to Part 2 until you are asked to do so.

Scoring

A list of acceptable responses was developed. The response had to point out what was wrong; suggested improvements without mention of the problem were not credited. Score was the number of acceptable responses.

53. IMPROVING LAWS AND CUSTOMS

Directions

In this test you will be given an opportunity to show how clever you could be in improving the way things are run. Each item will mention a well-known set of laws. For each one, try to indicate what you consider an important improvement that could or should be made. Your political attitudes do not count one way or another in this test.

For example, one item might be "The requirement to go to school for a certain number of hours and days until you attain a certain age." To say simply that you are "for it" or "against it" will earn you no credit, because you have not suggested a change or improvement. Good comments on this item about school might be: "Make school hours very short and make it possible for students to learn at home"; or "School should consist of work on different real-life jobs"; or "Have school last all year, but only up to age 12." Try to think of all the people who may be involved. For some items you may want to think about many kinds of people: workers, customers, children, taxpayers, or "the average citizen."

Your comments need not be in whole sentences, but they must be specific, relevant to the item, and meaningful.

Your score on this test will be the number of acceptable improvements which you suggest.

You will have 15 minutes for each of the two parts. Each part has 10 items. When you have finished Part 1, STOP. Please do not go on to Part 2 until asked to do so.

Scoring

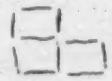
A list of acceptable responses was developed. General statements that offered no specific suggestion (e.g., they shouldn't do it, they should cost less, etc.) or descriptive statements of the process as it is now done were not credited. Score was the number of acceptable responses.

61. TOOTHPICKS TEST

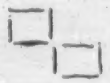
Directions

In this test you will be asked to make patterns of squares using toothpicks. You will be given a pattern of squares and asked to change it by removing some of the toothpicks. You can show which toothpicks are to be removed by drawing a short line though them. Look at the example below:

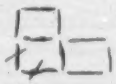
Take away 2 toothpicks
Leave 2 squares



To show this:

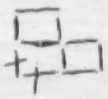


You mark like this:

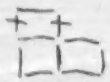


Whenever you make a pattern it must have complete squares with no extra toothpicks left over. The example below shows a correct and an incorrect solution to a problem; the incorrect solution is wrong because it leaves a toothpick which is not a part of any square.

Take away 2 toothpicks
Leave 2 squares



Correct



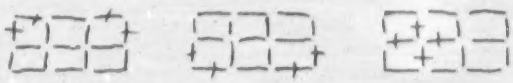
Incorrect

Sometimes it is possible to make both large and small squares or to make overlapping squares.

You will be asked to think of several different solutions for each item in this test. In some problems you will be told both how many toothpicks to remove and how many squares to leave; some problems will tell you only how many toothpicks to remove; some will tell you only how many squares to leave. Each answer that you give for an item must be a new pattern, based on a different rule or principle, and not just the same answer turned around or turned over.

Look at the examples below:

Take away 4 toothpicks:
Leave 3 squares



The first two examples are correct but both use the same rule--cross out the corner matches. Only one of these answers would count. The third example uses a different rule, leaving one large square and two small ones, so it would receive credit.

Your score on this test will be the number of correct solutions to each item using different rules.

You will have 5 minutes for each of the two parts of this test. Each part has one page. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

Scoring

A scoring guide illustrating solutions was developed. Each response was first checked to be sure that the correct number of toothpicks were crossed out and/or the correct number of squares remained and that all remaining toothpicks were part of one or more squares. Answers were credited if they were not duplicates, rotations, reflections, or inversions of previous solutions to the same problem. Score was the number of different solutions.

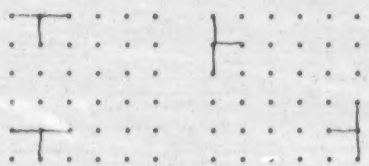
62. PLANNING PATTERNS

Directions

In this test you will be asked to plan how certain figures can be fitted onto a group of dots. You will be asked to think of as many different ways as possible to arrange the figures.

Look at the example below. Two possible solutions to the problem are shown at the right.

Make 2 T's
Each T must touch exactly 4 dots



In order to receive credit for a different pattern, you must place the figures in different positions relative to each other. Drawings which show the the figures in the same relative positions, as if the pattern were turned around or turned over, will not receive credit. The figures cannot reach outside the group of dots, touch each other, or overlap; that is to say that two letters cannot use the same dot or have their lines cross each other. The letters may be different in shape from each other as long as they are clearly recognizable.

Now try this practice item:

Make 3 L's
Each L must touch exactly 3 dots

Your score on this test will be the number of different solutions which you draw using different rules.

You will have 5 minutes for each of the two parts of this test. Each part has two pages. When you have finished Part 1, STOP. Please do not go on to Part 2 until asked to do so.

Scoring

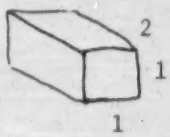
A scoring guide illustrating some of the possible solutions was developed. Any recognizable variation of the letters was credited. The number of letters produced and the dots touched was counted to eliminate incorrect responses. Answers were credited if they were not duplicates, rotations, or reflections of patterns previously used for the same problem. Score was the number of different solutions.

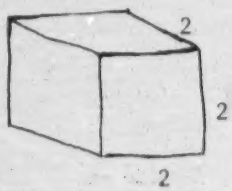
63. STORAGE TEST

Directions

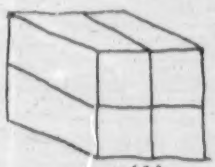
In this test you will be sked to plan how objects can be stored in a given space. You will be asked to think of as many different ways as possible to arrange the objects in this space.

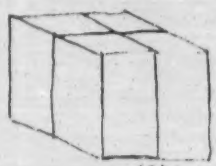
How many different ways can 4 boxes, like the one on the left below, be stored in the container shown on the right? The numbers on the sides of the figures are to help you compare sizes.

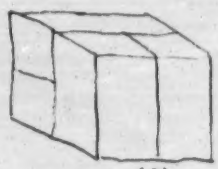




The drawings below show three correct solutions to this problem. Note that drawings (1) and (2) use the same rule. The rule is that all of the square ends of the boxes are on the same face of the cube. Drawing (3) uses a different rule.


(1)


(2)


(3)

Your score on this test will be:

2 points credit for each drawing which shows a new rule
1 point credit for each drawing which is not exactly the same as earlier drawings but which uses the same rule

You will have 3 minutes for each of the two parts of this test. Each part has one page. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

Scoring

A scoring guide was developed illustrating the possible solutions. All drawings were first checked to be sure the correct number of boxes was shown. Answers were credited if they were not duplicates or rotations of previous solutions for the same problem. Score was the number of different solutions.

71. MAKING GROUPS

Directions

In this test you will be asked to make groups of things which are alike in some way and to explain the reason for each group.

Each item in the test will have a list of seven things. You should try to think of ways in which these things are alike. Use the letters beside the names of the things to identify groups which are alike in some way. Then write what it is about the things that makes them alike.

Look at this example:	Group (letters)	Reason
a. airplane	a, b, c	means of transportation
b. boat	d, e, f, g	animals
c. car	b, e, f	found in water
d. bat	a, d, g	fly
e. frog		
f. trout		
g. robin		

You might have written down different groups or different reasons from those given in the sample.

Try to think of as many different ways as possible to make groups. Each group must have at least three things in it. The same group cannot be used with different reasons. The groups should be based on such characteristics as size, color, shape, or use and not on how the words are spelled or their sounds.

Try to think of as many different groups as possible (up to 10) for each item. However, if you have trouble of thinking of enough groups for one item, leave it and go on to the next item.

Your score on this test will be the number of correct groups that you make. Remember that a group must have both the letters of the objects and the reason for grouping them in order to be correct.

You will have 5 minutes for each of the two parts of this test. Each part has one page with two items. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

Scoring

A scoring guide giving examples of acceptable responses was developed. To be acceptable, a response had to list both the letters referring to the objects and the reasoning for grouping the objects. Each group had to contain at least three objects. The same group of objects was not credited twice even if different reasons were given. Acceptable reasons had to be based on the characteristics of the objects, not on such things as the spelling of the words or on personal opinions about the objects. Score was the number of acceptable groups.

72. DIFFERENT USES

Directions

In this test you are to think of different uses for common objects.

Each item will consist of the name of a common object and, in parentheses, a description of its usual use. You are to think of other ways in which the whole object, or parts of it, can be used. Write these uses on the lines provided.

Look at the example below:

MAGAZINE (used for reading)

Other uses:

swat mosquitoes

start a fire

make paper beads

Try to think of as many different uses (up to six) as you can for each object. Each use that you give must be really different from the others. For example, in the item above, you could not receive credit for both "swat flies" and "swat mosquitoes."

Your score on this test will be the number of acceptable responses which you give.

You will have 5 minutes for each of the two parts of this test. Each part has one page with four items. When you have finished Part 1, STOP. Please do not go on to Part 2 until you are asked to do so.

Scoring

A scoring guide listing samples of acceptable responses was developed. Common uses of the objects were not credited. Score was the number of acceptable responses.

73. LISTING OBJECTS

Directions

In this test you will be given a general description of a broad category which could contain many objects. You will be asked to write a list of as many objects as you can think of which would fit this category.

For example: List all the things you can think of that might be found in a school.

books

nap

pencils

paper

desk

Your score will be based on the number of different things which you list.

Your will have 2 minutes for each of the two parts of this test. Each part has one page. When you have finished Part 1, STOP. Please do not go on to Part 2 until asked to do so.

Scoring

Two scores were obtained for this test: (1) the total number of acceptable responses, and (2) the number of different categories of responses. The first score was thought to represent fluency, the second flexibility. An acceptable response was any object falling within the required category. Extremely unlikely responses (e.g., toothpicks used to build a house, tiger meat found in a kitchen, etc.) were not credited. A list of categories was developed for the second score. Because these two scores were highly correlated, they were combined for the final analysis.

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